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(54) **Retractable hull appendages for the trim control of planing craft**

(57) The object of the invention consists of a pair of retractable hull appendages to be installed on planing crafts, having the shape of planes or tables or fins placed astern, parallel to the port and starboard sides capable, when lowered, to create a lifting force in correspondence to the area astern of the boat.

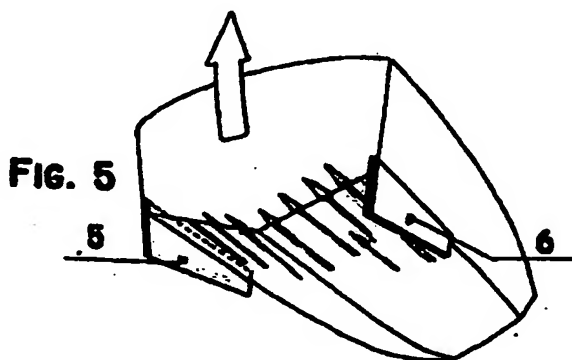
Such action is derived from the appendages which function as a barrier in order to prevent the fluid threads flowing under the keel from escaping sideways, thus

creating a water pressure rise under the stern.

The invention enables the boat to plane easily with less power involved, as a consequence of the reduction of the passive forces of resistance to the water caused by all trim control systems in use today.

Moreover, the compression of the fluid water threads under the keel enables the boat to acquire better propulsion.

Note: It is proposed that this abstract be published together with fig. n° 5



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Description

State of the art

[0001] It is a known fact that craft with a displacement hull - having practically a round-shaped body more or less thinned on the bows and astern, has a precise limit in its speed of advancement in the water.

[0002] In fact, even if the boat is equipped with a propulsion engine of great power, its bows tend to lift, whilst a very high wave train is created ahead which prevents the boat from overcoming the speed limit, which is proportional to the square root of the floating boat length.

[0003] For example, in the case of a ten metre long boat, the limit is of roughly seven knots; whilst for a sixteen metre one the limit is of nine/ten knots.

[0004] On the other hand, a hull having a plane bottom or a v-shaped stepped bottom is capable of raising itself upon the water, if equipped with suitable propulsive power.

[0005] In fact, in such conditions the submerged volume of the keel is reduced, and therefore the resistance to the advancement in the water is decreased.

[0006] In this way, even high speeds can be reached, no longer in proportion to the length of the boat; in this way, it is said that the boat is planing.

[0007] For example, a ten metre long boat can, when planing, reach a speed of thirty knots.

[0008] However, before reaching such planing, meaning the raising upon the water, the boat tends to lift its bows exactly as in the case of the displacement hull, and the propulsive power required to overcome this phase is undoubtedly very high, before entering the planing regime.

[0009] As early as fifty years ago, it was realised that a modification of the bottom under the transom facilitates the passage from the displacement navigation to the planing one.

[0010] Such modification is shown in Figure 1, where 1 is the transom of the boat in longitudinal section and 2 is the modified part of the bottom planking: practically a wedge is added to the extreme part of the planking.

[0011] This device, although useful when promoting the planing of the boat even in the case of boats with low propulsive power, soon proved to be often dangerous during some of the navigation phases, in particular with rough seas, and even more when sailing before the wind.

[0012] Every skipper knows that in such conditions one has to navigate at reduced speed with a submerged stem in order to be able to steer the boat properly.

[0013] As previously explained, the wedge would keep the stem raised and the boat would become unmanageable and in danger of capsizing.

[0014] It was understood that inclined planes located astern under the transom were certainly useful, however it was absolutely necessary that the planes could be mobile and that they could be lifted when finding oneself in

the conditions described above.

[0015] Therefore, mobile planes, *trim tables* commonly but incorrectly defined as "*flaps*" have come into use. These, being mobile and therefore capable of assuming even intermediate positions, present a second and no less important advantage: once the boat was brought to the planing regime, they could be partially retracted in order to keep the boat planing with considerably reduced fuel consumption.

[0016] In fact a ten metre hull, with slightly lowered flaps can proceed at a cruise speed of 20/22 knots with a limited fuel consumption, without having to constantly run at a speed of 30 knots in order to keep the planing regime; in rough seas, the flaps are totally lifted and the boat safely proceeds at 11/13 knots, although with considerable fuel consumption.

[0017] But if we examine the way that the flaps work by referring to Figure 2, we notice that the lowered flap receives water push normal at the same plane, N, which can split into two forces: a vertical V able to lift the stern of the boat and a horizontal T, which resists to drag.

[0018] In order to support the boat stern during the pre-planing phase, other devices were conceived, for example the Deltatrim flaps, which in fact reduce the passive resistance effect, but which have had little success because of the practical difficulties involved in installing them on the hull bottom. This type of trim control devices is shown in Figure 3, where the tables 3 with a triangular profile can be seen, pivoting around hinge 4 obliquely fitted under the keel.

[0019] In any case the drag resistance is considerable, and increases with the square of the speed, equally to the power required to overcome such effect.

Aim of the invention

[0020] In essence, the aim of the invention consists of a type of trim control devices, based on a different principle which, contrary to those in use today, reduce to the minimum the above described drag effect, and therefore allow the boat to plane with less power, and therefore, once planing, allow the boat to travel at the same speed with a saving of power and therefore of fuel.

[0021] The devised and proposed trim side fins are represented, in principle, in Figure 5 and basically consist of planes or tables 5 and 6 adjacent to the starboard and left sides, astern of the boat, and have the characteristic of being retractable.

[0022] They are completely lowered during the planing phase, to be gradually withdrawn, later, depending on the navigation regime.

[0023] The principle on which the retractable hull appendages object of the invention - better defined *trim side fins* rather than *flap* - are based is substantially different from the principle on which the trim tabs existing today and above described, are based.

[0024] In fact while the latter are based on a down-

ward deviation of the water flow under the boat, which creates a drag effect, the proposed ones prevent the fluid water threads from escaping sideways from below the bottom and therefore causing a compression of the water under the bottom and under the stem; this determines a lifting, facilitating the planing of the boat.

[0025] Moreover, by funnelling the exit of the water threads under the keel in a direction parallel to the course of the boat, an increased propelling push can be expected, analogous to the action of the intubated propellers.

[0026] Figure 4 represents a hull seen from below, where the flowing direction of the water threads below the keel has been indicated; as can be seen some flow parallel to the longitudinal axis of the keel but many, especially astern because of the pressure supporting the hull, also escape sideways, as can be noticed by observing from astern the wake left behind the boat.

[0027] On the other hand, in Figure 5 a hull can be seen, still from below, with the proposed trim side fins in a lowered position. It can be seen that the water threads are being kept parallel to the longitudinal axis of the hull.

[0028] The lowering of the trim side fins, in parallel to the water flow, and therefore with an incidence of 0 degrees, requires a modest effort on the part of the actuators that move the fins.

[0029] The hull appendages object of the invention described above in principle require particular features and embodiments from a practical point of view, depending on their installation either on hulls that are being newly built or on existent ones, and also in relation to the dimensions, speed and end use of the boat.

Description of the preferred embodiments

[0030] The following detailed description refers to two preferred embodiments - each having a different way of lowering the fins in the water - made by way of non-limiting examples and illustrated in the figures 6 up to 19

[0031] The first, easier and more economical, suitable for small/medium boats, involves fins equipped with a swinging movement, whilst the second involves fins equipped with a rectilinear vertical movement, more suitable to larger boats, to be installed during the construction phase.

[0032] Let us start with the description of the retractable swinging trim fins, illustrated in Figures 6, 7 and up to Figure 14.

[0033] Figure 6 shows in elevation a swinging fin 5 applied to the port - side 15 of the boat, and is shown as if the side 15 were transparent, the starboard fin is exactly symmetrical..

[0034] Figure 7 shows the same fin 5, but in perspective.

[0035] In both figures it can be observed that the fin 5 is provided with a fulcrum 7 around which the fin rotates; such fulcrum will have a considerable diameter in

relation to its thickness, in order to best sustain the push exercised by the water, but with a minimum transversal protrusion in order to limit the drag effect.

[0036] Such fulcrum is illustrated in more detail in Figures 13 and 14.

[0037] Moreover the fin is provided with an element, preferably a pin, 8 solidly anchored to its internal surface, the movement of which is controlled by the actuator.

[0038] Moreover the fin is provided with a connecting element 9, illustrated in detail in Figure 11, which allows both the permanent attachment of the fin to the boat side, and its upward and downward movement.

[0039] The connecting element 9 is articulated on a support 10, better represented in Figure 12, anchored on the transom next to the side edge.

[0040] In fact, the support is provided with a projecting flange 11 with a curvilinear profile whose radius corresponds to the distance between the flange itself and the centre of the fulcrum 7 around which the element 9 can run up and down remaining attached to the flange 11 itself.

[0041] The rotating movement of the fins is obtained in a conventional way, as in the case of the flaps, through hydraulic or electrical actuators, installed either on board or outboard, actuators that can directly act on the fin or even through suitable linkages

[0042] In Figure 6 and 7 such actuator is represented in the retracted position 12 and in the position of total release 13.

[0043] As a consequence in this installation the fin part protruding beyond the chine is the dashed one indicated with 14. We notice that the support 10 can be installed directly on the transom if the latter is vertical, whilst in the case of inclined transom, a layer 17 of wood or even of resin could be interposed.

[0044] From a construction point of view the fin could be made in any material.

[0045] For example Figure 8 shows a Z cross section of a fin 5a, correspondent to section X-X of Figure 6, which can be built in stainless steel plate or aluminium casting; Fig. 9 shows a structure also in stainless steel plate but with a rectangular box-type section; Figure 10 shows a fin 5c, with a solid rectangular section suitable to installations studied before the construction of the boat and can be made in marine resinated plywood or in polyester resin, suitably ribbed in correspondence to the attachments, in the way of the rudders.

[0046] For this type of fins a recess in the side is recommended, where the fin itself is located, in order to avoid any protrusions, as indicated in Figure 10.

[0047] In the following Figures other construction details of the model are shown, and precisely in Figures 11 and 12 the details of the retaining system and of articulation of fin 5 are shown: an anchoring element 9, with a L cross-section is sturdily jointed to the internal surface of the fin and slides on flange 11 with a curvilinear section of support 10. Element 9 will preferably be

garnished with plastic material such as DELRIN or similar as indicated in Figure 11, fixed with countersunk screws, in order to facilitate the sliding of part 11 and at the same time in order to avoid noises due to the fin hitting the hull, especially when the boat is riding at anchor.

[0048] An alternative system of the anchorage of the fin to the side is the one shown in Figure 15 where it can be seen that support 10b is equipped with a curvilinear slot 25 in which pin 9b is articulated solidly to the fin surface, same as the previously described element 9 which controls the holding in place and the sliding action of the fin itself. Moreover the pin can be extended and at the same time it can be controlled by the actuator 12 as illustrated.

[0049] In this case both functions fulfilled by pin 8 and element 9 can be more simply combined in pin 9b.

[0050] Figures 13 and 14 show in detail how can be made the fulcrum 7 around which fin 5 rotates when the fin is released or retracted. Figure 13 (section Y-Y of Fig. 6), illustrates that in the hull side 15 there is a recess in which the rotation fulcrum 7 is housed, so that no protrusion from the side is created.

[0051] Fulcrum 7 consists on a metal ring 22 anchored to boat side 15 with screws 23, and on it a ring 20 of plastic material will preferably be mounted in order to avoid metal to metal contact which could cause problems. Fin 5 turns around this metal ring and is held by a disc or a cover 24 fixed with screws 21 to metal ring 22 in order to prevent it from detaching.

[0052] Figure 14 illustrates the same fulcrum, should creating a recess in the boat side be undesirable. In this case the fin will be adjacent to the boat side and the rotation fulcrum will protrude from the boat side itself for a few centimetres, but its effect could be reduced with a suitable, triangular shaping situated in front of the protruding disk.

[0053] The second embodiment is now described, conceptually based on the same principle, which involves the use of fins equipped with a vertical rectilinear movement, parallel to their relative boat sides, instead of a swinging movement.

[0054] This model is illustrated in Figures 16, 17, 18 and 19. Figure 16 shows the left fin 5, in a longitudinal vertical cross section.

[0055] The fins in this model are characterised by the following features:

[0056] They are meant to be installed on motor-powered boats with the main goal of enabling the boat to keep optimum navigation in all conditions, and in particular to facilitate its planing and have therefore no resemblance to the retractable keel of sailing boats, even if similar in construction, being substantially different from the latter, apart from the fact that they are installed on another boat type, for the their specific function which is totally different.

[0057] In fact in this case the function is to avoid the boat making leeway, especially when the boat is sailing

beating and not to affect the longitudinal trim.

[0058] The fins, the object of the invention, are preferably of a rectangular shape, at least the onboard part, whilst the protruding part below the chine will present a hydrodynamic profile as highlighted in Figure 19.

[0059] The fins are contained in a case 26, of rectangular section with parallel rectilinear guide rails 27 in order to maintain the parallelism of the upward and downward movement of fin

[0060] The guide rails will preferably be trimmed with strips of plastic material 28. The case 26 could also be made of a simple frame equipped with guide rails 27, as the walls of the case are created directly into the boat structure. It is even better if the external walls are at one respectively with the boat side and the transom.

[0061] Case 26 containing the fin is equipped with a cover 30 to allow the direct extraction of fin 5 from inside the hull. In fact in all cases the level of this cover is above the floating line indicated as 31.

[0062] Figure 17 shows a cross section of the case, indicated with z-z in the figure 16, from which the guide rails 27 and their relative trimmings 28 can be more clearly seen.

[0063] Figure 18 is a detail of the previous one in order to represent more clearly the details 27 and 28.

[0064] Figure 19 — section w-w shows the hydrodynamic profile that the part of fin 5 in the area working under the keel must have.

[0065] In fact even if the fin is inserted parallel to the longitudinal axis of the boat, it is subjected to a water resistance force due to the friction exercised by the water flow and therefore with such device such effect may be reduced as much as possible.

[0066] The fin and the case that contains it can be built in any suitable material; so for example, in a boat with a polyester resin hull both the fin and the relative case will be preferably built in polyester resin too, whilst in the case of a boat built in aluminium, the same material will be used for the case, whilst the fin will be built in resin, better suited to being shaped with the due profile.

Claims

1. A pair of hull appendages mainly for motor boats, consisting of two flat surfaces that could also be termed tables or fins 5 and 6, one on the starboard side and one on the port side astern of the boat, protruding under the keel in order to prevent the sideways escape of the fluid water threads flowing under the keel during navigation, and therefore cause a rise of supporting pressure under the stern and, hence, a variation of the navigation trim of the boat.
2. A pair of hull appendages, as in claim 1, equipped with a device installed in both which enables them to protrude under the keel or, alternatively, to be re-

tracted in order to always achieve the best conditions for navigation, in particular when the boat passes from the displacement regime of navigation to the planing one.

3. A pair of hull appendages, as in claim 2, **characterised by** being equipped with a swinging movement around a fulcrum 7 located at its ahead extremity, and solidly anchored to the boat side.
4. A pair of hull appendages, as in claims 1 and 2, each provided with a vertical, rectilinear movement parallel to their respective boat sides.
5. A pair of hull appendages, as in claim 3, each equipped with an attachment or a pin 8 solidly anchored to the appendages internal wall, on which a mechanism consisting of an electrical or hydraulic actuator exercises its action, which determines its movement either directly or through suitable linkages.
6. A pair of hull appendages, as in claim 3, each equipped with a connecting element to the boat side or to the transom, in order to allow for a stable attachment to the hull and at the same time for the downward and upward movement of the swinging appendage around its fulcrum 7.
7. A pair of appendages, as in claim 3 where each, from the construction point of view, is equipped with a plate in stainless steel or aluminium 5a also equipped with longitudinal ribs in order to create a Z or C shaped cross section.
8. A pair of hull appendages, as in claim 3, where each appendage is **characterised by** having a rectangular cross section, either box-type 5b or solid 5c made of any suitable material, such as stainless steel, aluminium, plywood or polyester resin etc. swinging around the fulcrum anchored to the hull, adjacent to the boat side, contained in a dedicated recess created in the wall of the boat side itself.
9. A pair of hull appendages as in claim 3, where each appendage is equipped with a fulcrum 7 made as a metal ring 22 fixed to the boat side, prevalently having a considerable diameter in relation to its thickness in order to better resist to the water pushing force on the appendage level, but consisting of a minimal transversal protrusion to limit any drag effect. The metal ring 22 may be fixed with bolts to the boat side and the appendage that rotates around it bears a hole correspondent to the diameter of the ring with the possible interposition of a trimming ring 20. A holding element of the appendage is included in order not to let the appendage detach from the pin, which mainly consists of a disc

or cover 24 also fixed to the metal ring 22.

10. A pair of hull appendages, as in claim 5, where each appendage is **characterised by** the fact that it is equipped with a connecting device 9 to the transom essentially constituted by an element prevalently with a L cross section, solidly linked to the inside wall of the appendage and articulated on the flange 11 of a square support anchored to the transom in proximity of the boat side. Such flange presents a curvilinear profile whose radius is correspondent to the distance between the flange itself and the centre of the fulcrum on which the appendage rotates, in order to enable the linking element to oscillate up and down together with the fin to which it is fixed. The connecting element 9 could be equipped with a plastic trimming, such as DELRIN or similar.
11. A pair of hull appendages, as in claim 5, where each appendage, as an alternative to claim 10, is equipped with a connecting system to the transom consisting on an element 9b true to the fin itself, mainly consisting of a cylindrical pin, equipped with a disk of larger diameter at its extremity, articulated in a square support as in claim 10, but equipped with a slot 25 with a curvilinear profile, in order to allow for the swinging movement of the fin whilst still keeping it adherent to the boat side.
12. A pair of hull appendages, as in claim 11, in which the connecting element 9b consisting mainly of a cylindrical pin articulated in a slot, is extended in order to receive, at the same time, the action of the actuator that transmits the movement to the appendage. In this case the linking element fulfils the three functions of keeping the fin adherent to the boat side, of enabling its movement and lastly to transmit the action of the actuator.
13. A pair of hull appendages, as in claim 4, each preferably **characterised by** a rectangular or trapezoidal shape with a rectangular cross section in the part of the appendage located on board whilst the section of the protruding part will preferably have a cross section with a hydrodynamic profile.
14. A pair of hull appendages, as in the previous claim, each **characterised by** preferably being contained in a case 26, with a rectangular cross section, equipped with flat guide rails 27, rectilinear in order to keep the parallelism in the downward and upward movement of the fin.
15. A pair of hull appendages, as in claim 14, contained in a frame equipped with rectilinear guide rails, where the walls of the case would be directly created into the hull structure, and where the guide rails themselves would preferably be equipped with flat

trimmings of suitable plastic material 28.

16. Appendages as in claims 4, 14 and 15, contained in a case or structural frame equipped with cover 30 in order to allow for the inspection of the appendages from the inside of the hull, with the cover itself preferably above the floating line. 31. 5
17. Appendages, as in the previous claims, manufactured, both the fins themselves and the case containing them from any material as follows: for a polyester resin boat, it will be preferable to use the same material for both the fin and the case, whilst in the case of an aluminium plate hull the same material will be used for the case, whilst the fin will preferably be built in resin, better suited to being shaped with the due profile. 10 15

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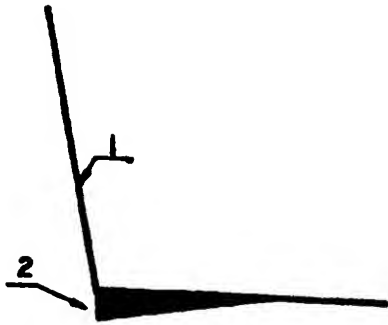


FIG. 1

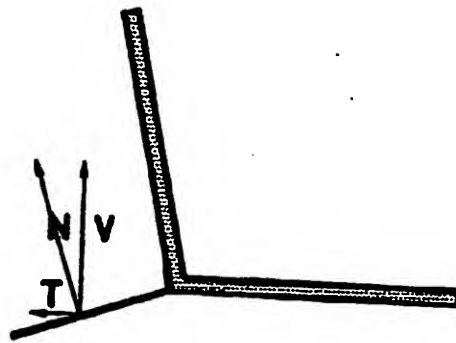


FIG. 2

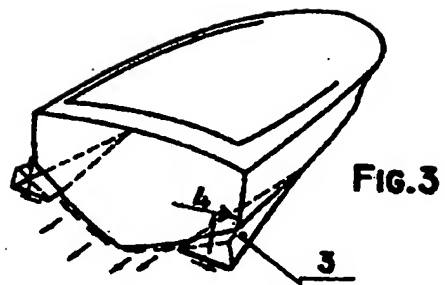


FIG. 3

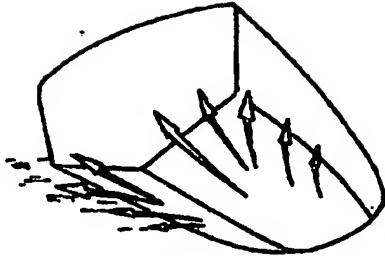


FIG. 4

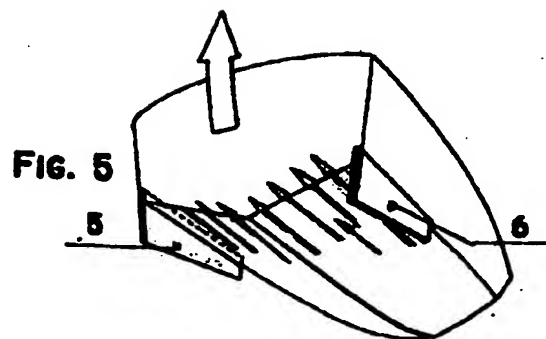


FIG. 5

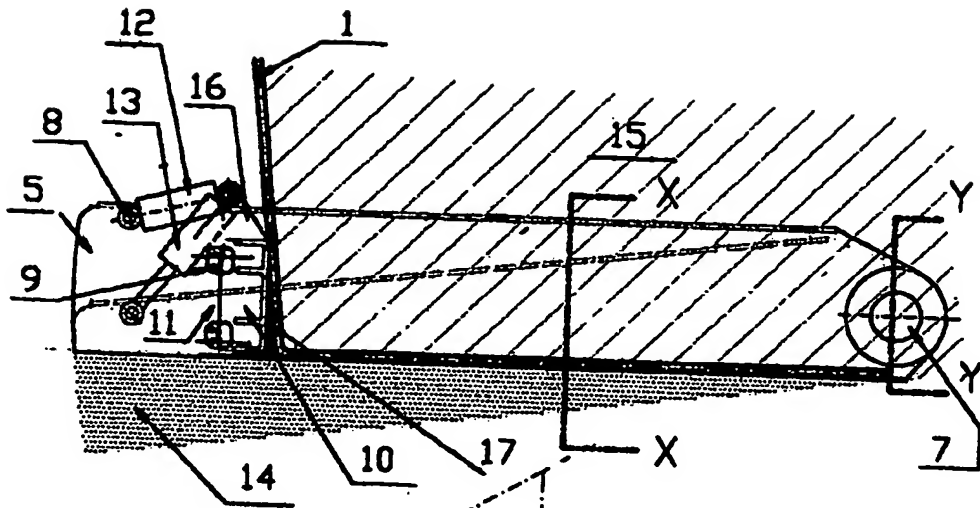


Fig. 6

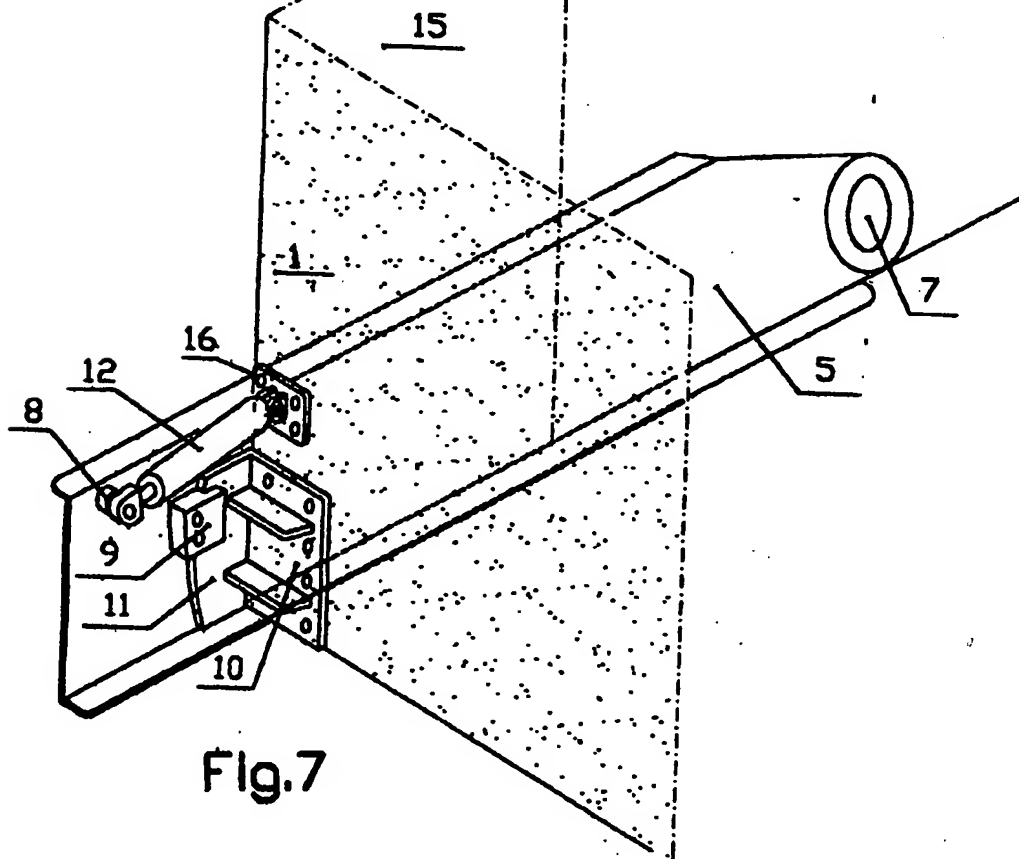
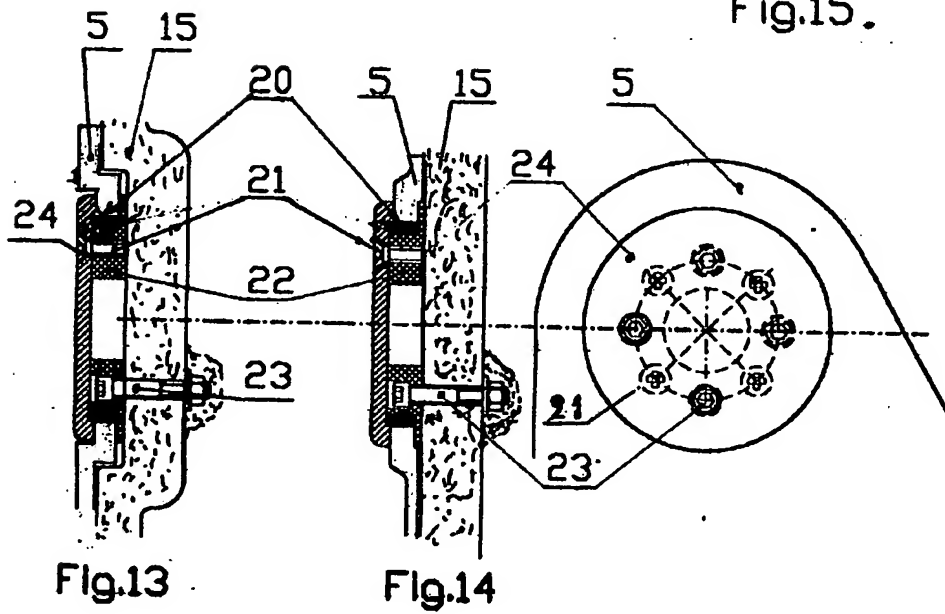
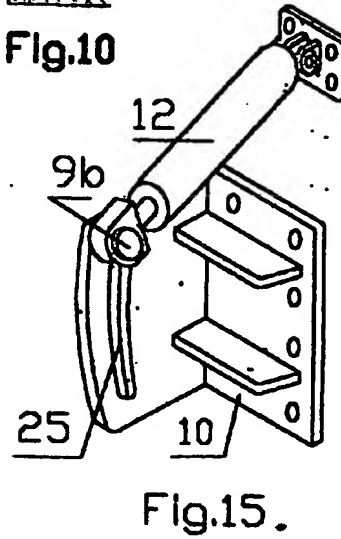
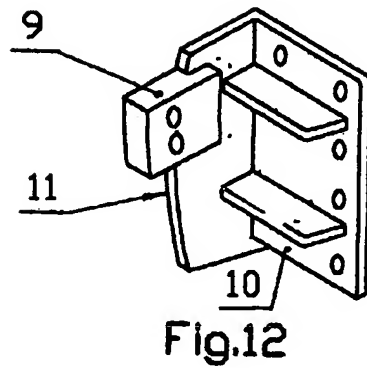
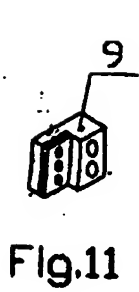
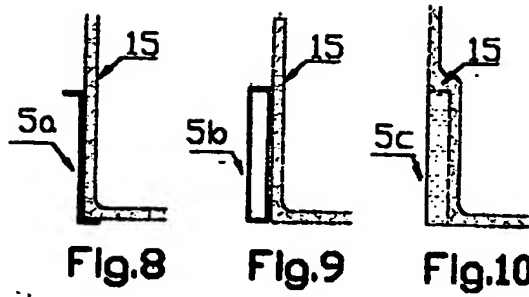


Fig. 7



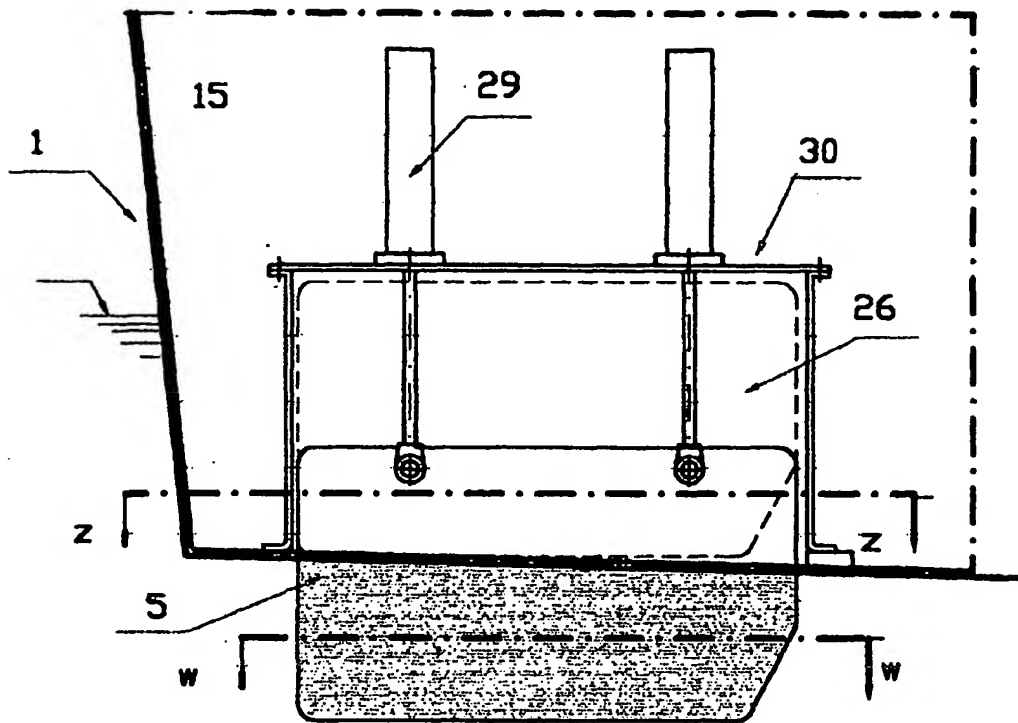


Fig. 16

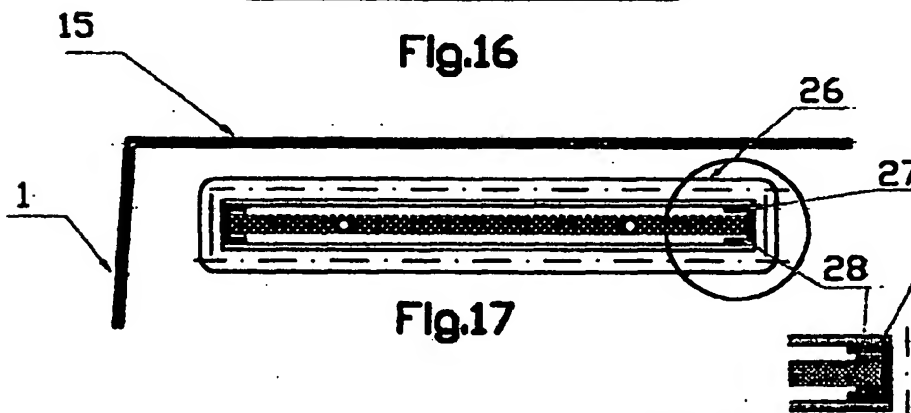


Fig. 17

Fig. 18

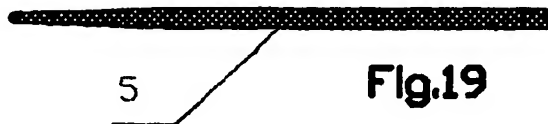


Fig. 19



European Patent
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EUROPEAN SEARCH REPORT

Application Number
EP 03 42 5744

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The present search report has been drawn up for all claims			
Place of search MUNICH		Date of completion of the search 28 April 2004	Examiner Moya, E
<p>CATEGORY OF CITED DOCUMENTS</p> <p>X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document</p> <p>T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document</p>			

EPO FORM 1503 (03.02.92) (pub.001)

**ANNEX TO THE EUROPEAN SEARCH REPORT
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This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
The members are as contained in the European Patent Office EDP file on
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